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EDWIN DUNKIN, F.R.S., President, in the Chair.

The Rev. Stephen Henry Saxby, M.A., East Clevedon, Somerset, was balloted for, and duly elected a Fellow of the Society.

Proposal for Photographing the Heavens.

(*Letter to the President, from Admiral Mouchez.*)

Monsieur le Président,—J'ai l'honneur de vous prier de vouloir bien présenter à votre illustre Société la photographie agrandie d'une partie de la voie lactée et le cliché obtenu directement avec le nouvel appareil photographique créé à l'Observatoire de Paris pour construire les cartes écliptiques. Cet appareil, muni d'un objectif spécial de $34^{cm.}$ de MM. Paul et Prosper Henry, semble avoir réalisé un très-remarquable et important progrès dans la photographie des étoiles.

Avec une heure de pose, nous obtenons les étoiles de 14^{e} et de 15^{e} grandeur. Si vous regardez le cliché avec une forte loupe ou mieux au microscope, vous verrez que toutes les petites étoiles sont triplées et les autres ont un contour un peu vague ; cela provient de ce qu'on a fait 3 poses de 1 heure chacune, à $4''{\cdot}5$ de distance de manière à obtenir 3 images de la même étoile en forme de triangle. On est certain ainsi de ne pas confondre des taches ou accidents de plaque avec des étoiles. Sur une étendue de $2° 15' \times 3°$, on compte près de 5,000 étoiles sur le cliché.

Notre nouvel appareil photographique est principalement destiné à continuer les cartes écliptiques ; mais je pense, Monsieur le Président, que vous jugerez, comme le savant et habile

Directeur de l'Observatoire du Cap, M. Gill, et comme moi, que le moment est venu d'utiliser un semblable progrès pour entreprendre la carte complète de la voûte céleste en établissant une entente entre 6 ou 8 observatoires bien placés dans les deux hémisphères.

Nos clichés pouvant représenter 7° superficiels, il en faudrait 6,000 pour obtenir toute la voûte céleste, et qui, réunis par 4, donneraient 1,500 feuilles semblables aux cartes écliptiques de l'Observatoire de Paris.

Six, huit, ou dix ans au plus permettraient de réaliser ce vaste projet et de léguer aux siècles futurs une image très-exacte du ciel à la fin du 19e siècle. La très-haute importance d'un tel projet, les nombreuses découvertes qu'il promet aux astronomes de l'avenir, m'engagent à vous prier de le soumettre à l'étude de votre illustre Société et de chercher, si on le croit réalisable, quel serait le moyen d'établir cette entente pour en préparer et en poursuivre l'exécution.

Veuillez agréer, Monsieur le Président, l'assurance de ma haute considération,

Le Contre-Amiral, Directeur de l'Observatoire,

E. Mouchez.

Observatoire de Paris:
le 20 Juin, 1885.

On Dr. Wilsing's Experimental Examination of the Wedge Photometer; and (II.) On the Degree of Accuracy attainable by means of that Instrument. By Prof. C. Pritchard, D.D., F.R.S.

In the *Astronomische Nachrichten* for Sept. 14, 1885 (No. 2680), Dr. Wilsing, of Potsdam, has honoured me by a very able and very elaborate criticism on the Wedge Photometer, extending over eighteen columns, and conceived in a fair and discriminating spirit. Dr. Wilsing's remarks apply chiefly to—

1. The possible influences on the measured magnitude of the fainter stars, when the brightness of the ground forms an important fractional part of the total intensity.
2. To non-invariability of the eye for any length of time.
3. To the effect of colour.

Such criticisms of new work are very valuable, and are so many posts on the road towards the establishment of fact. When Dr. Wilsing wrote this article on July 1 he was not aware of my paper, which was read and discussed at the June meeting of the Royal Astronomical Society; moreover, he was not in possession of that portion of the Oxford Photometry which applied to stars of the fifth and sixth magnitudes, and it is mainly on these stars of a fainter lustre, that some question has arisen as to the effect of the luminosity, greater or less, of the background, which he

considers, with Prof. Pickering, may affect the concluded magnitudes of the fainter stars. The whole catalogue, formed on Argelander's *Uranometria Nova*, is now completely printed, and will be published, together with an Introduction, by the Delegates of the Clarendon Press, by the time the present communication reaches the Fellows of the Society in print.

I will now take the leading points of Dr. Wilsing's criticism into consideration, *seriatim*, and make such remarks as I conceive may closely bear upon the subjects, and be interesting to the Society.

Dr. Wilsing commences his critique by referring to physiological questions regarding the impressions of light on the eye; especially in relation to Fechner's law and experiments connected therewith. Fechner has virtually translated the physical relations of light, in its passage through media, into nerve-impressions on the brain; and he has extended them with some ingenuity to other sensations besides those of light. With regard to these obscure physiological relations, I desire to keep aloof from them in this communication to the Royal Astronomical Society, and I propose to confine myself solely to the region of experimental and observational fact.

The results of Fechner's experiments, so far as I understand them, are these. In regard to intensities of light, not extreme in their character, he states that an alteration in the intensity of light will be perceptible to the eye, if it amount to about one-hundredth of the whole. I confess I was at first disinclined to suppose that so small a variation was within the limits of appreciation. I resolved therefore to repeat Fechner's experiment, and it has been so repeated at the University Observatory. Two contiguous shadows were formed on white paper, by two lights, which effectively differed, approximately in the ratio of 100 : 1. The difference between the illuminations represented by 100 and 101 was just perceptible, and it was only with hesitation that it could be said the same remark was not applicable even to the ratio 120 : 121. The experiment was varied by *looking through tracing paper*, instead of confining it to *reflected* light, and with approximately the same results. We are therefore constrained to admit that such feeble differences of light are in reality capable of producing impressions on the visual organs under the conditions aforesaid.

There is also another remark of Fechner's which may be found to bear more or less on stellar photometry, to the effect that it is the *ratio* of the difference to the whole which is capable of making visual impression, rather than the feeble illumination in and by itself. This fact was virtually, though not formally, known to the Greek astronomers, who divided their successive magnitudes into thirds, whether they referred these subdivisions of light to the first or to the sixth magnitude; and it will be remembered that one-third of the light of a first magnitude star is in intensity equal to about *thirty* times the whole light of a

sixth magnitude star. This may appear a somewhat startling remark, nevertheless it expresses a fact.

Now it is mainly on this capacity of the human eye for the discrimination of feeble differences in the ratio of two lights, that it has been conceived that the background on which stars are viewed may exercise an influence on the determination of the magnitude of feeble stars, not much brighter than the background itself, on which they are projected. The preceding considerations are entirely theoretical as applied *to the case of stars in the sky*, with which alone we have now to deal. In my last communication to the Society I showed that, so far as *Polaris** was concerned, its apparent magnitude was not affected in the telescope by the phase of the Moon; and it was also shown that on making a selection of stars in various parts of the heavens, differing greatly in stellar density, no effects of this varying density could be detected by a comparison between the resulting magnitudes in the Harvard and Oxford tables to the fourth magnitude. Prosecuting this inquiry still further into the case of the stars of the fifth and sixth magnitudes, now that my whole catalogue is completed, I have found that this same remark still holds as respects the non-interference of background or stellar density; always remembering two facts—first, that the comparison is made with the Harvard Catalogue; and secondly, that the least difference of light measurable in stellar photometry, whether by the wedge or any other known sidereal photometer, does not go beyond the thirteenth or fourteenth of a magnitude, instead of reaching nearly to the hundredth of a magnitude, as suggested by Fechner and confirmed at Oxford. This latter remark is of prime importance. The feeble differences in light ratio of 100 : 1 referred to in Fechner's experiment, apply solely to large illuminated *surfaces*, viewed with both eyes, and not to mere *points* of light viewed with such instrumental appliances as exist in sidereal photometry. Even in Seidel's instrument, where the stars are expanded into discs, no greater delicacy of discrimination existed than in the Wedge, or in the Zöllner, or in the Meridian Photometer. Sidereal photometry, definite and beautiful as I regard it to be, in its recent aspects, is not of such delicacy that tests and strictures which properly apply to such inquiries as Fechner's are legitimately applicable, or even possible, when applied to the stars. Moreover, minute disturbing influences which may properly be taken into account in experiments and theoretical inquiries regarding the measurability of impressions of light in general, are negligible, and in fact *must* be neglected in all cases of sidereal photometry.

* If it be remarked that the effect of the moonlight is there examined in reference only to so bright a star as *Polaris*, it may be sufficient to state that ordinary scattered moonlight is extinguished by the wedge, in the 4-inch telescope, at less than an inch from the thinner end, whereas a star of the sixth magnitude is extinguished therein, at a place on the wedge more than two inches and a half from the extremity.

The presence of other stars in the field of the telescope, as limited by the photometer, produces a background of a different character from that already described. This field of view in the 4-inch telescope is confined to a circle of 0·02 inches diameter in the focal field, equivalent to about 80″. A reference to Argelander's charts will indicate the fact that in very few instances indeed will so contracted a field comprise with a sixth magnitude star any other star ranging from the seventh to the tenth magnitude. A seventh magnitude is very rare: if it be within 20″ of the star to be measured, then it would be placed in the category of double stars, and its character would be referred to in the Notes. It would, if viewed as one point of light, coalesce with a sixth magnitude, and would have a combined result of 5·6. If, on the other hand, the small star, or the two or three small stars in the field, be detached from the brighter star they would produce distinct impressions on the retina, *and would be completely extinguished by the wedge* long before the extinction of the brighter, and could produce absolutely no influence on its measure in the photometer. Precisely the same sort of reasoning applies to the measurement of fainter stars in a larger telescope, say of twelve inches or any greater aperture. The photometric field in such telescopes is still more restricted, and the very faint stars possibly accompanying the one to be measured, would either coalesce as a double or multiple star, and be noted as such; or they would be extinguished by the wedge long before the extinction of the brighter.

The effect of the coalescence of two stars upon the magnitude of the brighter is shown in the following short table:—

Difference in Mag. of two Stars whose lights coalesce.	Resulting addition of brightness to the brighter Star in Mag.	Difference in Mag. of two Stars whose lights coalesce.	Resulting addition of brightness to the brighter Star in Mag.
0·0	0·75	2.0	0·16
0·5	0 53	3·0	0·07
1 0	0·37	4 0	0·03
1·5	0·25	5·0	0·01

These considerations are sufficient to indicate the freedom of this form of photometer from the influence of the greater or less density of stars illuminating various regions of the heavens (always within the limits of accuracy prescribed).

I come now to another point insisted on by Dr. Wilsing—viz. the varying sensitiveness and fatigue of the observer's eye in the course of observations during any one night, and at remotely distant intervals of time. This is a fair question, requiring a fair consideration. The consideration which I shall give it is, as in other parts of this paper, a practical one; and it does not extend to such extreme cases as some of those referred to by Dr. Wilsing —viz. to a continuation of the observations throughout *five* hours on a single night. In order to assure myself of the non-existence

of this source of error, a large number of extinctions of *Polaris* made on separate nights have been examined. These extinctions of *Polaris* are usually made three times on each night—viz. at the beginning, the middle, and the end of the series. No trace of a systematic difference is found, indicating symptoms of varying sensitiveness of the observer's eye, depending on these sequences of time. Moreover, as the measures are strictly differential, and as the mean of the three sets of readings of the extinction of *Polaris* (which rarely differ much *inter se*) is used for all the observations of the series, the mean condition of the eye is maintained throughout. In point of fact, there are continual breaks in the work of observation, connected with the shifting of the dome, the identification of the stars, and recording the results; and the whole series is rarely permitted to occupy more than three hours in the night. All these circumstances combine to prevent any undue strain on the eye of the observer.

Regarding the question of colour, another point in Dr. Wilsing's critical examination, I can only repeat what has been so strongly insisted upon in vol. xlvii. of the Society's *Memoirs*, viz. that so far as colours not very salient are concerned, the wedge interval for them is identical with that for light in general. At the same time I cannot repress the conviction that the photometry of intense colours is not as yet accomplished.

II.

On the Amount of Accuracy attainable by the Wedge Photometer.

In order that there may be no misapprehension as to the actual amount of accordance existing between the individual measures, or between the several determinations of adopted magnitudes derived from taking the mean of the former, I append the two following tables. The first gives the detail of one night's work, of an average character, on the extinction of *Polaris*, and on the determination of the magnitude of one star (72 *Tauri*), as the result of the mean of the four sets of five measures which form the usual or normal method of the two observers. Sufficient explanation is afforded by the headings of the several columns.

The second table gives the results of ten or twelve nights' repetition of the determinations of the magnitude of each of sixteen selected stars. They comprise among them, as a matter of interest, the seven *lucidæ* in *Ursa Major*, and also μ and R. 204 *Andromedæ*; the latter were used in the determination of the varying magnitude of the *Nova* in the *Andromeda* nebula, from nearly its first outburst to the time when it seemed to settle down into a star of approximately the tenth magnitude.

TABLE I.

Original Observations for the Determination of the Difference of Magnitude of Polaris and 72 Tauri.

Date and Instrument employed.	Original Readings of Wedge for extinction of *72 Tauri*.	Mean Wedge Readings of extinction of *Polaris* at beginning, middle, and end of series.	Wedge Interval in inches.	Magnitude equivalent to Wedge Interval.	Assumed Magnitude of *Polaris*.	Resulting Magnitude of *72 Tauri*.	Finally adopted Mean Mag.
	in.	in.					
1884, Dec. 20.	2·65	4·602					
With Wedge A on 4-inch	·53	·592					
telescope.	·72	·606					
	·65						
	·71						
Mean	2·652	4·600	... ...	3·56	2·05	**5·61**	
With Wedge A on 2-inch	1·90	3·828					
telescope.	·83	·868					
	·79	·840					
	·92						
	·86						
Mean	1·862	3·845	... ...	3·69	2·05	**5·74**	**5·65**

Date and Instrument employed.	Original Readings of Wedge for extinction of 72 *Tauri*.	Mean Wedge Readings of extinction of *Polaris* at beginning, middle, and end of series.	Wedge Interval in inches.	Magnitude equivalent to Wedge Interval.	Assumed Magnitude of *Polaris*.	Resulting Magnitude of 72 *Tauri*.
	in.	in.				
With Wedge B on 3-inch	1·30	2·682				
telescope.	·27	·698				
	·29	·682				
	·34					
	·26					
Mean	1·292	2·687	1·395	3·62	2·05	**5·67**
With Wedge B on 1½-inch	0·71	2·076				
telescope.	·60	·084				
	·74	·062				
	·70					
	·79					
Mean	0·708	2·074	1·366	3·54	2·05	**5·59**

TABLE II.

Magnitudes of Stars observed on many Nights.

Date of Observation 1880.	Individual Magnitudes.	No. of Extinction.
	β Ursæ Majoris.	
2·913	2·14	20
3·062	2·20	10
3·070	2·18	10
3·078	2·15	10
3·081	2·09	10
3·089	2·09	10
3·092	2·10	10
5·467	2·19	10
5·483	2 27	10
5·485	2·30	10
Mean ...	... **2·17**	
Average deviation	0·06	

Date of Observation 1880.	Individual Magnitudes.	No. of Extinction.
	α Ursæ Majoris.	
2·913	1 90	20
3·062	1·92	10
3·070	1·85	10
3·078	1·90	10
3·081	1·98	10
3·089	1·89	10
3·092	1·92	10
5 467	1·88	10
5·483	1·81	10
5·485	1·80	10
Mean ...	... **1·89**	
Average deviation	0·04	

	γ Ursæ Majoris.	
2·938	2·34	20
3·062	2·31	10
3·070	2·27	10
3·095	2·20	10
3·100	2·31	10
5·467	2·45	10
5·483	2·19	10
5·485	2·28	10
5·505	2·47	10
5·514	2·13	10
5·519	2·15	10
5·533	2·45	10
Mean ...	... **2·30**	
Average deviation	0·09	

	δ Ursæ Majoris.	
2·938	3·39	20
3 062	3·37	10
3·070	3·36	10
3·095	3·36	10
3·100	3·53	10
5·467	3·40	10
5·483	3·43	10
5·485	3·55	10
5·505	3·34	10
5·514	3·56	10
5·519	3·37	10
5·552	3·35	10
Mean ...	... **3·41**	
Average deviation	0·06	

	ε Ursæ Majoris.	
2·938	1·80	20
5·467	1·70	10
5·483	1·91	10
5·485	1·75	10

	ζ Ursæ Majoris.	
2·938	1·95	20
5·467	2·08	10
5·483	2·18	10
5·485	2·14	10

Date of Observation 1880.	Individual Magnitudes.	No. of Extinction.
	ε Ursæ Majoris.	
5·505	1·70	10
5·514	1·79	10
5·519	1·89	10
5·533	1·80	10
5·552	1·85	10
5·565	1·79	10
Mean ...	... **1·80**	
Average deviation 0·06		

Date of Observation 1880.	Individual Magnitudes.	No. of Extinction.
	ζ Ursæ Majoris.	
5·505	2·16	10
5·514	2·04	10
5·519	2·23	10
5·533	2·02	10
5·552	2·09	10
5·565	2·03	10
Mean ...	... **2·09**	
Average deviation 0·07		

	η Ursæ Majoris.	
2·957	1·75	20
5·467	1·69	10
5·483	1·79	10
5·485	1·83	10
5·505	1·67	10
5·514	1·79	10
5·519	1·88	10
5·533	1·80	10
5·552	1·75	10
5·565	1·73	10
Mean ...	... **1·77**	
Average deviation 0·05		

	β Cassiopeiæ.	
2·835	2·32	20
5·514	2·34	10
5·519	2·40	10
5·533	2·35	10
5·552	2·36	10
5·565	2·52	10
5·571	2·56	10
5·574	2·43	10
5·697	2·42	10
5·724	2·32	10
Mean ...	... **2·40**	
Average deviation 0·07		

	γ Cassiopeiæ.	
2·810	2·19	20
5·514	2·27	10
5·519	2·22	10
5·533	2·21	10
5·552	2·42	10
5·565	2·50	10
5·571	2·55	10
5·574	2·34	10
5·724	2·34	10
5·732	2·24	10
5·738	2·14	10
5·749	2·27	10
5·751	2·27	10
Mean ...	... **2·23**	
Average deviation ·09		

	δ Cassiopeiæ.	
2·810	2·89	20
5·514	2·89	10
5·519	2·94	10
5·533	2·93	10
5·552	3·02	10
5·565	2·88	10
5·571	2·91	10
5·574	2·92	10
5·697	2·84	10
5·724	2·81	10
5·732	2·94	10
Mean ...	... **2·91**	
Average deviation ·04		

Date of Observation 1880.	Individual Magnitudes.	No. of Extinction.
	α Cygni.	
2·430	1·38	20
3·068	1·31	10
3·148	1·33	10
3·164	1·28	10
3·167	1·25	10
3·170	1·34	10
5·533	1·39	10
5·552	1·42	10
5·565	1·25	10
5·574	1·30	10
Mean ...	... **1·33**	
Average deviation	·05	
	η Persei.	
2·699	4·14	20
2·702	4·13	20
2·705	4·09	20
2·708	4·19	20
3·103	4·14	10
3·106	4·05	10
3·108	4·13	10
3·169	4·13	10
3·174	4·09	10
3·207	4·14	10
Mean ...	... **4·12**	
Average deviation	·03	
	μ Andromedæ.	
2·693	3·98	20
5·692	3·94	10
5·692	3·89	10
5·697	3·90	10
5·724	3·95	10
5·724	3·96	10
5·732	3·85	10

Date of Observation 1880.	Individual Magnitudes.	No. of Extinction.
	γ Cygni.	
2·430	2·28	20
3·068	2·23	10
5·533	2·35	10
5·552	2·31	10
5·565	2·17	10
5·574	2·18	10
5·724	2·31	10
5·732	2·18	10
5·738	2·21	10
5·749	2·31	10
5·751	2·22	10
Mean ...	... **2·28**	
Average deviation	·06	
	α Andromedæ.	
2·685	2·01	20
2·693	2·05	20
2·697	2·09	20
5·533	2·02	10
5·552	2·24	10
5·565	2·17	10
5·574	2·02	10
5·697	2·00	10
5·721	2·05	10
5·732	2·03	10
5·749	2·02	10
5·751	2·05	10
Mean ...	... **2·05**	
Average deviation	·05	
	R. 204.	
4·012	5·92	20
5·697	5·95	10
5·724	6·11	10
5·724	6·03	10
5·732	6·01	10
5·735	5·92	10
5·738	5·87	10

Date of Observation 1880.	Individual Magnitudes.	No. of Extinction.	Date of Observation 1880.	Individual Magnitudes.	No. of Extinction.
	μ Andromedæ.			*R.* 204.	
5·735	3·91	10	5·749	5·86	10
5·738	3·96	10	5·752	5·88	10
5·749	3·91	10	5·757	5·99	10
5·752	3·98	10	5·782	5·98	10
5·757	3·97	10	5·792	3·97	10
5·782	3·93	10			
5·792	3·97	10			
Mean ...	... **3·94**		Mean ...	... **5·96**	
Average deviation	·03		Average deviation	·06	

From these two tables conclusions of considerable interest and importance may be derived in relation to the amount of accuracy to be looked for in the determinations of magnitude published in the *Uranometria Nova Oxoniensis*.

On inspection of the second table, it appears that very little improvement in accuracy is gained in general by repeating the measures through many nights, provided the first twenty usual determinations are made on a night free from abnormal or saliently varying meteorological conditions. Nevertheless, a small number of discordances do, and I fear must, occasionally occur, and nothing but re-observations can eliminate such errors from any catalogue. The final results, so far as my powers of scrutiny extend, exhibit no symptoms of systematic error. The average deviation from the mean for all these repeated observations on so many nights still remains approximately the same as for stars measured in the normal manner on a single fair night, viz. about 0·06 magnitude; and this, I think, represents in reality the utmost average delicacy attainable with the Wedge Photometer, and I claim for it an accuracy at least as great as has been yet attained by any other instrument.

This magnitude 0·06 corresponds to about $\frac{1}{18}$ of the whole light of the star whose magnitude is measured; and it must be remembered that it involves the combination of the error made in the extinction of *Polaris* with that of the star. In order to compare this result with the accuracy attained in other photometrical experiments such as Fechner's, &c., it will be necessary to divide this amount by $\sqrt{2}$, which gives $\frac{1}{25}$ of the light, as the limit of sensitiveness of this species of observation. As we have already seen, the utmost delicacy of appreciation attainable by shadows, as exhibited by my own repetition and modification of Fechner's experiment, is $\frac{1}{100}$ of the whole light. Bouguer sets it down, from his own researches, as $\frac{1}{64}$ approximately. Mr. Dixon, in some recent photometrical experiments on lighthouse illuminants, regards it as practically about $\frac{1}{50}$. Such being the

case, even when the lights are on surfaces of appreciable extent, and viewed leisurely by both eyes, $\frac{1}{25}$ of the whole light is, after all, a not unsatisfactory amount of discriminating power in the case of a star viewed with a single eye as a point, and with that eye under a certain degree of instrumental constraint.

Lastly, I append a list—I wish it were a shorter one—of all the stars in the Northern Hemisphere where I find a difference exceeding one-third of a magnitude between the Harvard and Oxford catalogues, referred to the same scale in relation to *Polaris*. Wherever I found the existence of this amount of difference, I felt it desirable to repeat my observation. In almost every instance, as shown by the notes in my *Uranometria*, I have (within the prescribed limit of error) recovered the determination previously made. This is in accordance with the remark made respecting the sixteen stars set down in Table II. Still I do not by any means intend to affirm a conviction that my own results are always unimpeachable. It may be remarked that these stars are scattered through all magnitudes, and over all parts of the sky. They amount to about five per cent. of the whole number observed, and it must not be forgotten that these discordances in the two catalogues are derived from differences of measures of *two* stars, each affected with its own error of observations; in point of fact there are four independent fallible measures in each of the discordances arising from the comparison of the two catalogues.

TABLE III.

List of Stars in the Harvard and Oxford Catalogue (Uranometria Nova Oxoniensis) in which the difference exceeds one-third of a Magnitude.

Name of Star.	Mag. at Oxford.	Mag. at Harvard −0·1.	Difference.
ι Androm.	4·56	4·20	0·36
32 Aquarii	5·60	5·14	·46
P. XXI. 421	6·07	5·75	·32
67 Aquarii	6·45	6·10	·35
P. XXII. 250	6·05	5·67	·38
χ Aquarii	5·52	5·05	0 47
5 Aquilæ	6·09	5·65	·44
ν Aquilæ	5·08	4·70	·38
τ′ Arietis	5·42	5·08	·34
R. 1328	5·85	5·44	·41
19 Aurigæ	5·42	5·00	0·42
θ „	3·03	2·57	·46
κ „	4·81	4·36	? Var.
α Boötis	+0·69	+1·07	·38
B. A. C. 4830	6·10	5·74	·36

Name of Star.	Mag. at Oxford.	Mag. at Harvard −0·1.	Difference.
ν' Boötis	4·64	4·99	0·35
P. III. 51	4·55	4·06	·49
P. III. 177	5·03	4·65	·38
3 Camelop.	5·78	5·27	·51
31 „	5·52	5·13	·39
μ Cancri	5·55	5·15	0·40
ψ „	6·02	5·68	·34
P. VIII. 67	5·38	4·99	·39
o Cancri	5·53	5·11	·42
β Can. Ven.	4·53	4·20	·33
R. 3074	5·96	6·34	0·38
Sirius	+1·95	+2·53	·58
η Can. Min.	5·66	5·21	·45
1 Cassiop.	5·22	4·89	·33
4 „	5·49	5·07	·42
P. o. 118	5·48	4·90	0·58
ξ Cassiop.	5·19	4·70	·49
P. o. 162	5·70	5·26	·44
θ Cassiop.	4·68	4·33	·35
50 „	4·40	3·96	·44
ν Cephei	4·84	4·40	0·44
ϵ „	4·76	4·14	·62
B. A. C. 8180	5·98	5·61	·37
13 Comæ	5·47	4·99	·48
16 „	5·39	4·99	·40
μ Aquilæ	5·10	5·58	? Var.
δ Coronæ	4·87	4·46	·41
15 Cygni	5·42	4·93	·49
22 „	5·14	4·57	·57
25 „	5·52	5·10	·42
47 Cygni	5·03	4·67	0·36
λ „	4·90	4·47	·43
55 „	5·39	4·90	·49
ϵ Delphini	3·59	4·03	·44
π Draco.	4·84	4·45	·39

Name of Star.	Mag. at Oxford.	Mag. at Harvard −0·1.	Difference.
P. XX. 376	6·15	5·80	0·35
4 Equulei	5·76	6·08	·32
ν Geminor.	4·33	3·88	·45
30 ,,	5·19	4·52	·67
33 ,,	5·75	5·34	·41
ρ Geminor.	4·45	4·05	0·40
o ,,	5·02	4·57	·45
β ,,	1·36	1·02	·34
λ Herculis	4·70	4·19	·51
87 ,,	5 73	5·29	·44
W. B. XVII. 1438	6·17	5·56	0·61
98 Herculis	5·68	5·28	·40
W. B. XVIII. 76	5·91	5·54	·37
η Hydræ	4·42	4·07	·35
ρ ,,	4·66	4·21	·45
L. 17835	6·00	5·51	0·49
1 Lacertæ	4·64	4·04	·60
W. B. XXII. 1133	6·06	5·50	·56
81 Leonis	5·77	5·37	·40
86 ,,	6·03	5·62	·41
89 Leonis	6·09	5·63	0·46
2 Lyncis	4·73	4·23	·50
21 ,,	4·88	4.47	·41
P. VII. 169	5·50	5·10	·40
B. A. C. 6203	5·66	5·24	·42
W. B. XVIII. 794	5·62	5·29	0·33
θ Lyræ	4·64	4·24	·40
8 Monocerotis	4·89	4·30	·59
12 ,,	6·03	5·59	·44
P. VI. 257	5·98	5·62	·36
68 Ophiuchi	4·75	4·32	? Var.
67 ,,	4·35	3·92	0·43
70 ,,	4·35	4·01	·34
π^2 Orion.	4·86	4·32	·54
π^3 ,,	3·62	3·23	·39

Name of Star.	Mag. at Oxford.	Mag. at Harvard −0·1.	Difference.
τ Orion.	3·95	3·55	0·40
v ,,	4·91	4·56	0·35
42 ,,	5·45	4·50	? Var.
45 ,,	5·78	4·85	? Var.
W. B. V. 1048	6·00	5·58	0·42
χ' Orion.	5·06	4·55	0·51
L. 11382	5·04	4·63	? Var.
μ Orion.	4·69	4·19	0·50
15 Pegasi	5·92	5·53	·39
ι ,,	4·24	3·89	·35
52 Pegasi	6·22	5·76	0·46
70 ,,	5·04	4·55	·49
16 Persei	4·77	4·33	·44
σ ,,	4·73	4·29	·44
o ,,	4·40	3·91	·49
W. B. III. 942	5·93	5·60	0·33
27 Piscium	5·30	4·93	·37
47 ,,	4·94	5·27	·33
58 ,,	6·00	5·60	·40
τ ,,	4·24	4·63	·39
λ Serpentis	4·68	4·25	0·43
π ,,	4·48	4·89	·41
59 ,,	5·50	5·11	·39
15 Sextantis	4·89	4·41	·48
D. M. + 21° No. 539	5·99	5·58	·41
P. III. 215	6·07	5·58	0·49
P. III. 234	5·80	5·45	·35
37 Tauri	4·84	4·35	·49
ω ,,	5·08	4·55	·53
71 ,,	5·03	4·51	·52
P. IV. 82	6·00	5·58	0·42
109 Tauri	5·44	5·05	·39
115 ,,	5·69	5·28	·41
121 ,,	5·77	5·33	·44
B.A.C. 516	5 66	5·27	·39

Name of Star.	Mag. at Oxford.	Mag. at Harvard —0·1.	Difference
10 Trianguli	5 55	5·19	0·36
24 Ursæ Majoris	4·92	4·49	·43
ϕ „	4·73	4·33	·40
B.A.C. 3821	6·06	6·47	·41
„ 3985	5·58	5·23	·35
5 Ursæ Minoris	4·72	4·19	0·53
P. XVI. 182	5·92	5·44	·48
ξ Virginis	5·21	4·82	·39
64 „	5·97	5·58	·39
71 „	5·93	5·56	·37
84 Virginis	6·00	5·63	0·37
P. XIV. 12	5·44	4·87	? Var.
109 Virginis	4·04	3·62	·42
110 „	4·99	4·46	·53
12 Vulpec.	5·49	4·92	·57
13 Vulpec.	4·97	4·56	0·41
B.A.C. 6966	5·09	4·66	·43
λ Ceti	4·93	4·50	·43
31 Leonis	4·87	4·50	·37
χ „	4·98	4·62	·36

On summing up the details of the two catalogues as completed, I find that there exists a mean difference of magnitude of 0·15 in the magnitude of a single star. The mean difference between my magnitudes and those given in the *Durchmusterung* is 0·06 mag. These two catalogues, therefore, notwithstanding many individual discordances, may, in the average and on the whole, be regarded as in substantial agreement.

It will be remarked in reference to the above list, that it comprises stars of all magnitudes, though principally stars fainter than the third. They are scattered over all parts of the sky. They comprise about four per cent. of the whole number of stars compared. Each of them has been purposely re-observed at Oxford. But it must not be overlooked that the discordances are in reality between *four* fallible measures.

The result of our labours at Oxford is now open to scientific scrutiny. Inasmuch as this *Uranometria* is the first complete and

systematic research of the kind, undertaken photometrically by a European astronomer, it can scarcely fail to possess some historical relation. If, as I hope and anticipate, its general usefulness and accuracy shall be acknowledged, I trust it will not be forgotten that a very considerable share of both is due to the intelligent, unremitting, and scrupulous attention of the two assistants, Mr. W. E. Plummer, F.R.A.S., and Mr. C. A. Jenkins, F.R.A.S., by whom the necessary instrumental measurements have been made; in the aggregate they exceed seventy thousand.

Photometric Observations of the Nova in the Andromeda Nebula, made at the Oxford University Observatory. By Prof. C. Pritchard, D.D., F.R.S.

The following observations were taken for measuring the brightness of the new star in the *Andromeda* nebula. It was not observed at Oxford till Sept. 7, when its brightness was compared with that of μ and ν *Andromeda*, resulting in 8·25 mag. for the *Nova*. The star then rapidly declined in lustre until about the end of September, when it approached closely to the tenth magnitude. Since that time its brightness has faded so nearly to that of the nebula, that it is no longer measurable by the Photometer. Even during the latter part of the observations there has been very considerable difficulty in observing with exactness the magnitude of this star, on account of the brightness of the nebula in the background, which closely approaches that of the *Nova* in that portion of the nebula, near to which the star is situated. The image of that part of the nebula which appears in the photometric field, small as it is, and not exceeding a circle 25″ in diameter, nevertheless occupies a small *area* on the wedge, varying minutely in thickness, so that when the star is near the point of extinction some trace of an unextinguished light from the nebula is faintly visible.

From some cause or other, possibly connected with what has just been mentioned, the behaviour of the star in the nebula, as it approached extinction on the wedge, *even* in the earlier observations, was somewhat different from that of an ordinary star. It did not resemble the perfect point-like appearance which other stars present when near to extinction. In the large Refractor, however, no perceptible difference was observed between the *Nova* and other stars of similar brightness.

The following table contains an account of all the observations taken to fix the brightness of the *Nova* :

Date of Obs. 1885.	Magnitude of Nova when compared With *Polaris.*	With *μ Androm.*	With *ν Androm.*	With *R.* 204	Adopted Mean Mag. of Nova.
Sept. 7 (*a*)	—	8·16	8·34	—	8·25
9 (*b*)	8·44	8·51	8 50	—	8·48
11 (*c*)	9·19	9·20	—	9·19	9·19
13	—	9·08	—	9·01	9·05
18 (*d*)	—	9·44	—	9·23	9 34
21 (*e*)	9·89	9·92	—	9·70	9·84
21	10·07	10·09	—	9·96	10·03
24 (*f*)	9·63	9·77	—	9·57	9·66
25 (*g*)	9·81	9·95	—	9·80	9·85
26	9·66	9·68	—	9·80	9·71
30	9·65	9·72	—	9·71	9·69
Oct. 1 (*h*)	9·64	9·71	—	9·79	9·71
3	9·94	9·76	—	9·93	9·88
5	10·02	10·02	—	9·90	9·98
7	10·06	10·16	—	9·97	10·05
12	9·60	9·93	—	9·89	9 81
16 (*i*)	9·97	9·89	—	10·02	9·96

Notes.

(*a*), (*h*) Partially fine night; sky hazy.
(*b*) Drifting cloud. Definition not good. (*c*) Definition bad.
(*d*) Sky very hazy; drifting fog and cloud.
(*e*) Sky variable and foggy. Observation unsatisfactory.
(*f*) (*g*) Moon nearly full; definition bad. (*i*) Sky foggy.

Oxford University Observatory:
1885, *November* 12.

Observations of the Spectrum of the New Star in the Great Nebula in Andromeda, made at the Royal Observatory, Greenwich. By E. W. Maunder.

The spectrum of this object was observed with one or other of the spectroscopes of the Royal Observatory on the evenings of September 4, 11, 15, and 30. On the first occasion, when the half-prism spectroscope was used, both in the direct position, and reversed in order to give greater purity, the star gave a perfectly continuous spectrum, in which no lines either bright or dark could be detected. The red, orange, and violet were very faint or altogether wanting, the spectrum being traceable from about D to F, but being scarcely discernible beyond those limits. The spectrum of the star resembled that of the nebula precisely, except of course that it was brighter, and, probably in

consequence of this greater brightness, was traceable a little further in both directions.

On the evening of September 11 the single-prism spectroscope was employed, and the lower dispersion of this instrument proved more suitable for the examination of so difficult an object. The spectrum of the star was now traced from about λ 6600 to λ 4300; it was very faint in the red and orange, and began to brighten at a definite point, either D or close to it. Then followed a space relatively very bright, the centre of which was not far from E, but the brightest part of which was further towards the red, at a point for which two readings were obtained, viz. λ 5457 and λ 5508, mean λ 5482, and where at times the brightening appeared so definite as to suggest the presence of a bright line. The same general region was also much the brightest in the region of the nebula. The spectrum of the star declined rapidly in brightness beyond F; practically, it might be considered as confined between the two lines, D and F, the outer portions of the spectrum were so much fainter than the central district. From time to time bright lines were suspected in this district, the brightest being the line already mentioned, a second being measured as at λ 5327. The region of the *b* lines was specially examined, and also the neighbourhoods of both D and F, but no bright lines were seen in either locality.

The spectrum of the star was examined with a small prism held behind the eye-piece, on September 15, and the presence of the two bright lines was again suspected. And again on September 30 they were more satisfactorily observed, although the star had then lost much of its brightness, and its spectrum was but little brighter than that of the nucleus of the nebula. A third line was also suspected about as far beyond the magnesium line λ 5527 towards the red, as the brightest of the three bright lines, viz. that at λ 5482, was towards the blue. This would give it's position as λ 5575. It could not be decided whether the lines were brighter than on September 11. They were recognised more easily than on that occasion, but, on the one hand, it was now known where they should be looked for, and on the other, the instrument now employed (the half-prism spectroscope in the reversed position) was the same as that used on September 4, when no trace of a bright line could be perceived. It was believed that the brightest line, that of λ 5482, could be traced over or near the nucleus of the nebula, but with so feeble a spectrum it was most difficult to make perfectly sure. The slit also was narrow, and it was found most difficult to keep either star or nebula upon it, their spectra being so faint that they were continually being lost.

On September 11 the spectra of two neighbouring stars were examined with a view to ascertaining whether the faintness of the extreme portions of the spectra of the star and nebula was due to either the spectroscope, the observer's eye, or the general feebleness of the light to be examined, or indicated a real deficiency in

the objects themselves of those kinds of light. The following rough settings were obtained for the limits of visibility of the spectra of two neighbouring stars, the new star and the nebula. The stars examined were Arg. Zone + 38°, Nos. 90 and 88.

Object.	Mag.	Limit towards the Red. Reading. r.	Limit towards the Red. Wave length tenth metres.	Limit towards the Violet. Reading. r.	Limit towards the Violet. Wave length tenth metres.
Arg. Z. + 38° No. 90	5·5	5·0	7380	85·0	3948
Arg. Z. + 38° No. 88	8·0	10·0	6858	76·0	4095
Nova	8·3	12·0	6615	64·0	4319
Nebula	—	17·0	6196	62·0	4363

It will be understood that the positions obtained are but very rough, as there was no definite point to be measured in any case; the micrometer, indeed, was only read to the nearest whole revolution.

The spectrum of the *Nova* was traceable a little further in both directions than that of the nebula. Towards the violet this seemed entirely due to its greater brightness, but towards the red the difference was greater than could fairly be explained upon this ground. The spectrum of the *Nova* seemed slightly brighter than that of No. 88 in the central district from D to F, but was decidedly feebler in the red and violet regions. The *Nova* was estimated as being three-tenths of a magnitude fainter than No. 88.

The colour of the star appeared to be about that of the D lines, and so far as could be judged it did not vary in tint from night to night, although it grew steadily less intense. On September 30, the last night of observation, a slight orange flush was still distinguished.

Its magnitude was roughly estimated as follows:—September 4, 8·0; September 11, 8·3; September 18, 9·2; September 21, 9·6; September 30, much fainter, and not greatly brighter than D'Arrest's star near it, or the nucleus of the nebula. The *Nova* was examined on two nights, September 18 and 21, to see if any disc could be detected. Both nights were foggy, and the nebula was all but extinguished. On September 21, whilst M. 31 was all but invisible, M. 32 was easily seen. The latter was therefore decidedly the brighter of the two. The *Nova* was perfectly sharply defined and free from fuzziness on both occasions. On September 18, with power 220, "the faintest suspicion of a larger disc than a star should show," was recorded. On September 21 "it bore every power up to and including one of 500, quite as well as the neighbouring stars. It was distinctly and sharply stellar in appearance, nor could anything be detected which could reasonably be termed a disc."

The observations were all made with the South-East Equatorial of 12·8 inches aperture and 17 feet 10 inches focal length.

Royal Observatory, Greenwich:
1885, *November* 12.

The Outburst in Andromeda. By Rev. S. J. Perry.

The *Nova* in *Andromeda* has been observed at Stonyhurst on every favourable occasion from September 13 to November 8. On September 13 the spectrum was found to be continuous, but the red end was absent, and there was a decided maximum in the green. A bright band in the green was suspected but not clearly seen. The spectroscope was carefully focussed on the lines in the spectrum of β *Andromedæ*, which were well seen, before being turned on the nebula of *Andromedæ*. On October 9 the spectrum was still brightest in the green.

The brilliancy of the *Nova* decreased at first very rapidly, but at present, although it is still very decidedly stellar, as is made evident by increase of power, there is no great change from day to day, the magnitude remaining at about the eleventh. With a low power the nucleus alone is visible, but with powers of from 200 to 300 the *Nova* still stands out very prominently, and is undoubtedly more brilliant than the nucleus.

Stonyhurst Observatory:
1885, *November* 11.

Note on Mr. Chambers's suspected New Variable in Corona Borealis. By Rev. T. E. Espin.

The star observed by Mr. Chambers is the variable star No. 109 of Gore's catalogue of known variable stars. It is there termed *V Coronæ*. The variation was discovered in 1878 by Dunér.

The star was observed by me on the night of June 9, 1885, with 9-inch Equatorial Reflector, during the reobservation of Birmingham's red stars, and I was as much surprised as Mr. Chambers at finding so finely coloured a star where Birmingham and Ball had previously found none. I extract from my note-book the observation of it.

"This star must be variable; Ball and Birmingham (4 obs.) did not see it. It was at once seen to-night, and identified as DM+40°·2929. Colour fine red. There is a star 8·0 DM+40 2928 6′·3 N. of it. The neighbouring star S, DM+39°·2920 is evidently underrated by Argelander, who gives it 9·4. It is now nearly equal to DM+39·2923, whose magnitude, according to Argelander, is 8·9. The red star is about 9·0 mag."

Dunér's discovery of its variation was announced in the *Astr. Nach.* No. 2227.

High Street, Wolsingham, Darlington:
1885, *November* 7.

Notes on the Total Solar Eclipse of September 9, 1885, viewed at the Terrace, Wellington, New Zealand. By Charles Rous Marten, F.R.G.S., F.R.Met.Soc.

(*Communicated by Prof. Adams.*)

The following are simply what they profess to be—"Notes"—and do not claim to be in any sense complete or exhaustive observations. Such elaborate and extensive preparations had been made for the observation of the eclipse by the regular official authorities, that I assumed that these would furnish all the results ordinarily desired, and accordingly I devoted my own attention rather to certain details respecting which I felt personally interested. Finding, however, that the official observations were in a large degree marred by unfavourable weather, I send, for what they may be worth, such general notes as I made, having been fortunate in enjoying a perfect view of the phenomenon. The particular details to which, as mentioned above, I addressed my especial attention, I have not time now to deal with, but I may do so at a future date.

The day of the eclipse was ushered in by most unpromising conditions of weather—a strong southerly gale blew from seaward, bringing dense masses of cloud and a very low temperature.

Westward the sky was fairly clear, but eastward the cloud canopy was very heavy. The Sun was not once visible until 7.4 A.M., but from that time forward it was never seriously obstructed by clouds. My position was in my front garden, at an elevation of about 100 feet above the level of the bay; my apparatus was of the simplest kind. An exceptionally good binocular field-glass, darkened glasses for use before and after totality, an excellent chronograph, self-registering thermometers by Casella.

At 7.4 A.M. the solar disc, then partially eclipsed, showed itself through a rift in the clouds. The clouds then cleared off, excepting on the horizon, and an absolutely perfect view was obtained thenceforward to the conclusion. No noteworthy diminution of light could be discerned by the mere vision until fully two-thirds of the solar disc had become covered, but from the time the first decrease in illumination was noticeable, the light faded very swiftly. The sunlight in New Zealand is usually exceedingly brilliant, far more so than in England, and quite as vivid as in most tropical countries. I observed the difference on the one hand, and the similarity on the other, in my recent visits to England and Brazil.

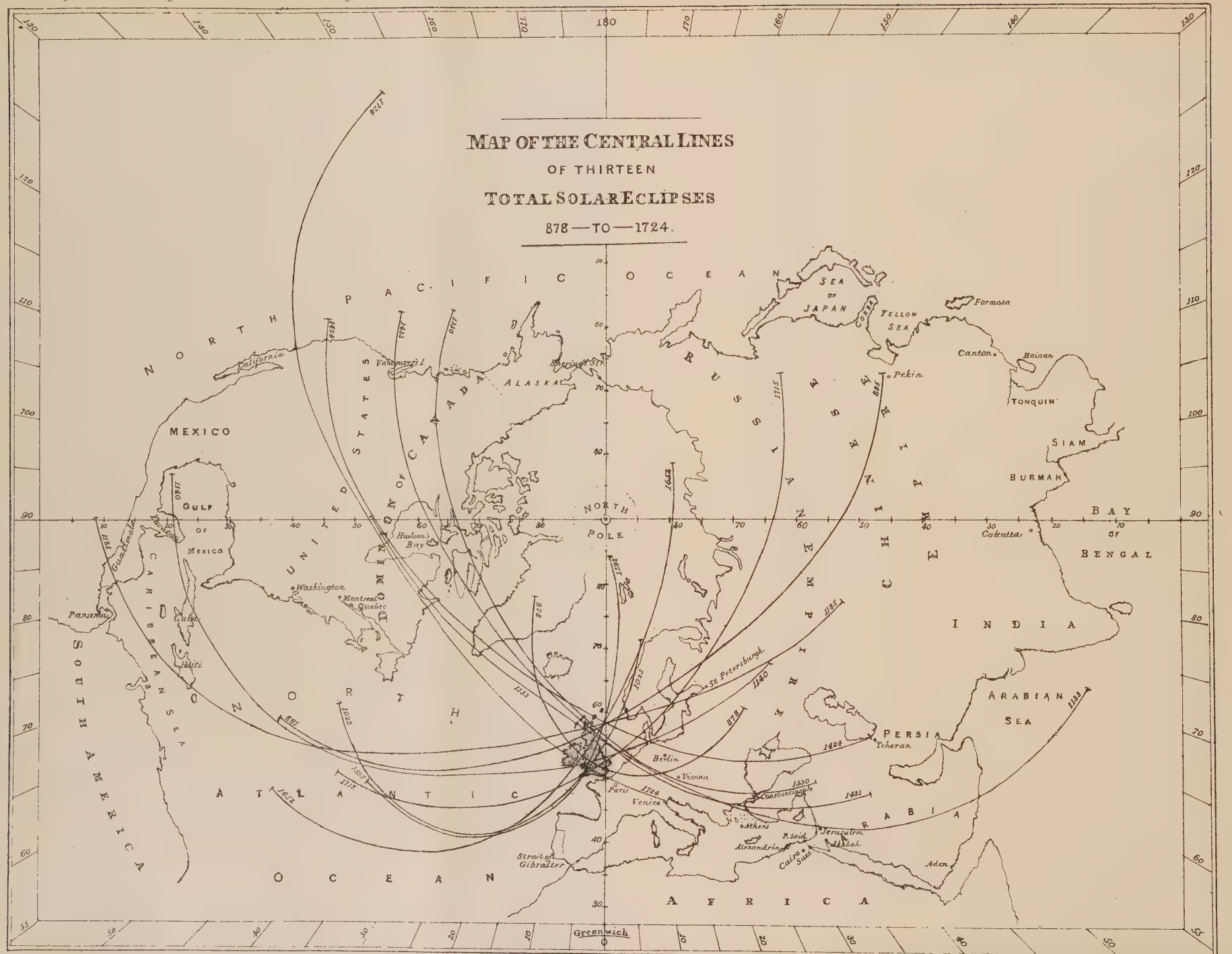
As totality approached, the effects of light and shade on terrestrial objects were very weird and striking. I may add that they differed materially in intensity from those I have observed in two former eclipses. There was a curious mixture of purple and green and bronze in the hues pervading the hills, while the blue sky deepened into iron grey and then to a leaden

tint, the waters of the bay looking like ink. The white and light coloured had a strangely wan, pallid look. I mention these points because I attribute the effects to the same cause that produces the fore-glow and after-glow which have preceded sunrise and followed sunset so frequently during the last two years. I shall have occasion to return to this matter.

Shortly before totality, I should say fifteen to twenty seconds—but I was unable to take the time with precision, being otherwise occupied—the entire disc of the Moon became suddenly visible against the white background of the solar corona, and then the approach of the dark shadow of totality could be plainly seen as it moved swiftly across the landscape. An instant before totality the solar light was concentrated into one intensely brilliant point, strongly resembling the light of the electric arc, and then came the complete obscuration. The darkness was not so great as I had anticipated, being about equal to that of a moonlight night in the Moon's first quarter. I attribute this partly to the amount of light reflected from the bulky masses of cumulous cloud which hung around the horizon, and partly to the illuminating influence of the "glow" which surrounded the eclipsed Sun like a huge rosy-mauve halo. A watch face could be easily read at the darkest period.

The corona presented a splendid spectacle surrounding the jet-black lunar disc. It was deeply serrated, or rather "rayed," pearly white with rays streaming out to a distance of fully two lunar diameters, and in the case of one on the upper left quadrant, more. Another long ray proceeded from the lower right quadrant, and there was an apparent equatorial protuberance. The whole appearance of the corona almost exactly resembled that of the Aurora Australis as I have often observed it at my former observatory in the extreme south of New Zealand, then the most southern observatory in the world. There was also a seeming unsteadiness at times noticeable in the auroral light, and a distinctly varying degree of luminosity in the coronal rays, while near the lunar edge there was, on the advancing side just after totality, and on the retreating side just before the reappearance of the Sun, a yellowish tinge, the rayed structure was very marked at the moment of absolute centrality.

The red prominences were visible in remarkable brilliancy to a far greater extent than I have ever seen described in accounts of other total eclipses. To describe their extent very roughly, I should say that, taking a clock face and its minutes as the gauge, one serrated series of prominences on the upper limb of the Sun, resembling a mountain range of red flames, extended from $0^h\ 54^m$ to $0^h\ 3^m$ in full brilliancy, and that red traces extended on the left hand to $0^h\ 52^m$, and on the right to $0^h\ 4^m$. Other large but narrow red prominences were at $0^h\ 39^m$ and at $0^h\ 20^m$. I fancied I saw a fourth momentarily at $0^h\ 30^m$. These "times" will be distinctly understood to indicate merely the *positions*—



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regarding the Sun's disc as a clock-face—and as I have explained at the outset, I cannot pretend to any great exactness in fixing them, as much of my attention was otherwise engaged. The prominences were very rich in colour and seemed, like the corona, to vary in intensity. They also seemed to vary in depth of hue, ranging from pink or rose to scarlet and almost to crimson. They had a markedly transparent appearance, like a light shining through coloured glass. I found I could see them quite plainly with my naked eye, after once having ascertained their position by means of the glass.

The "glow" seen before sunrise and after sunset now appeared in great beauty and richness of tint, surrounding the eclipsed Sun. The pink, rose, and mauve hues, the latter deepening to violet, and then fading to lavender, were very fine. The glow had extended round the dark body of the Moon as it advanced over the Sun, and similarly it preceded the Moon as it passed off the Sun's face. None could be seen on the uneclipsed side of the Sun. The exact time, carefully taken by chronograph, which elapsed between the final disappearance of the last sparkle of solar light on the right hand and the reappearance of the first sparkle on the left was 1 min. 32·9 secs.

The temperature, which was 49°·1 at sunrise, gradually fell during the eclipse, and finally receded to 43°·6, a fall of 5°·5. This was a smaller difference than I had expected. I imagine the smallness was due to the strong gale blowing, which must have tended to equalise temperatures. I fancy also that the disturbed state of the atmosphere may possibly be responsible for the seeming variation and unsteadiness of the coronal light and red flames.

Jupiter was very clearly visible during totality, also several stars, but the time was too short to allow of my recording particulars in addition to my other notes.

I forward these rough notes, *quantum valeant*, and can only express my regret that I had not, in anticipation of possible failure in the case of the official observations, made arrangements for observing the eclipse fully, and having telescopic, spectroscopic, and photographic records taken. However, if my very crude notes should prove of any service I shall be more than repaid my trouble in writing them.

The Terrace, Wellington:
1885, *September* 9.

Total Solar Eclipses A.D. 878 *to* 1724. By Joseph Maguire.

In the May number of the *Monthly Notices* parts of the central and limiting lines of these thirteen eclipses are shown on a map of the British Isles.

The map sent herewith, and to which this communication

refers, shows the completion of the central lines from beginning to end; and perhaps its publication in the *Monthly Notices* may not be considered undesirable.

The Greenwich Mean Times of beginning and ending, with the longitudes and latitudes in each case, are given as follows:—

Date.		Beginning.			Ending.	
		Long. W.	Lat. N.		Long. E.	Lat. N.
	h m	° ′	° ′		° ′	° ′
878 Oct. 29	0 37·5	42 8	73 0			
,, ,, ,,	1 52				36 51	53 41
885 June 15	20 54·5	58 24	29 50			
,, ,, ,,	23 34·6				117 37	40 24
1023 Jan. 23	22 57·6	55 52	38 26			
,, ,, 24	0 34·7				16 24	71 6
1133 Aug. 1	22 36·5	90 42	53 11			
,, ,, 2	1 29				71 44	10 2
1140 Mar. 20	0 27	96 19	20 38			
,, ,, ,,	3 8·4				48 14	56 16
1185 Apr. 30	23 44·6	90 6	8 56			
,, May 1	2 39·8				70 30	50 20
1330 July 16	2 2·5	144 4	49 53			
,, ,, ,,	4 31·8				38 14	37 28
1424 June 26	1 10·2	125 4·6	36 53			
,, ,, ,,	3 49·6				51 12	36 21
1433 June 17	1 26·7	135 26	43 57			
,, ,, ,,	4 1·7				44 48	30 46
1598 Mar. 6	21 20·7	42 35	34 5			
,, ,, ,,	22 57·1				3 54	84 10
1652 Apr. 7	21 16·2	51 33	22 27			
,, ,, ,,	23 29·4				130 6	76 33
1715 May 2	20 24·5	46 53	32 4			
,, ,, ,,	22 48·9				130 1	54 47
1724 May 22	3 42·7	152 6	14 21			
,, ,, ,,	6 37·8				11 51	45 31

Norwich:
1885, *September.*

Daylight Occultation of Aldebaran on July 9, 1885, *observed at Forest Lodge, Maresfield.* By Captain W. Noble.

Although the Moon's age was about 26·43 days, her bright limb, at moments of good definition, was seen sharp and clear against the sunlit sky. *Aldebaran*, too, was brilliant enough at intervals, but the undulation was at times very great indeed. Most unfortunately, one of these fits of "boiling" came on just as the Moon's limb was in contact with the star, so that the best estimation I could make of its disappearance was that it occurred on July 8, $23^h\ 25^m\ 17^s{\cdot}8 \pm$ Local Mean Time $= 23^h\ 25^m\ 0^s{\cdot}00$ G.M.T. I made no attempt to observe the reappearance. Power employed, 74 on my 4·2-inch Ross Equatoreal. Latitude of my observatory, 51° 0′ 56″·3 N.; longitude, 17·8 seconds E.

Forest Lodge, Maresfield, Uckfield:
1885, *July* 9.

Erratic Meteors. By B. J. Hopkins.

As is well known to observers of meteors, the apparent paths of those bodies, as seen by us projected upon the celestial vault, are generally in the form of a curve, but sometimes they appear to travel in straight lines, while a comparative few have no appreciable path, being seen only as points of light, which are no sooner observed than they are gone.

There is, however, a class of meteors that I have occasionally observed, though never found described in the text-books, which differs from those usually seen in that they travel in a zigzag or wavy path; from which circumstance and the rarity of their appearance I propose designating them "erratic" to distinguish them from ordinary meteors, which, it is perhaps needless for me to mention, they resemble in every other particular.

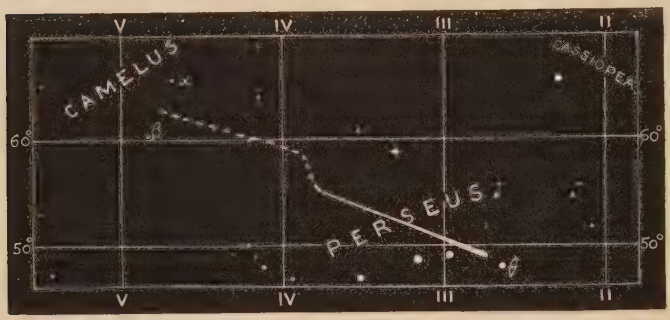
As I have said, these meteors are very rarely seen; I first observed one in the year 1879, and I have only noticed two since—one in 1881 and the other on September 9 of the present year. Details of these meteors I give in the following extracts from my note-books, which, together with the charts showing their course among the stars and the form of their paths, will make clear what I mean by erratic meteors.

Extracts from Note-books.

1879, Oct. 20.—$10^h\ 49^m$ G.M.T. Observed a bright yellow meteor, which described a zigzag path with two bends, as shown in diagram. Appeared between α and β *Cameli*, disappeared near θ *Persei*.

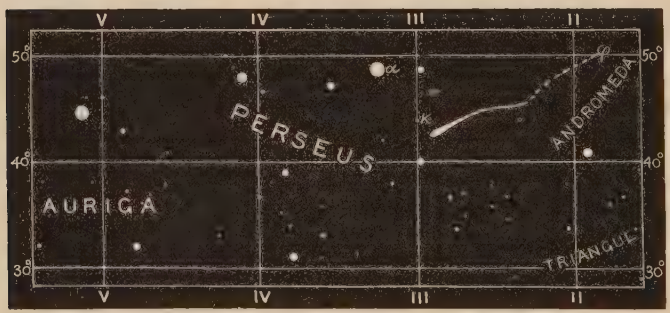
1881, June 25.—$12^h\ 4^m$ G.M.T. Observed a bright white meteor = 4. Appeared just south of κ *Draconis*, disappeared near γ *Ursæ Majoris*, after pursuing a wavy path.

1885, Sept. 9.—10^h 15^m G.M.T. Bright orange-coloured meteor=2. Appeared near ϕ *Persei*, disappearing just north of κ *Persei*, after describing a zigzag path with three bends.



Meteor of 1879, Oct. 20.

Meteor of 1881, June 25.



Meteor of 1885, Sept. 9.

For the sake of clearness, the scale being so small, the bends in the paths, as shown on the charts, are greatly exaggerated; in no case did a bend extend over more than 20 minutes of arc.

Forest Gate, Essex.

On the Application of a Nicol's Prism to Sextant Observations.

By Thomas Mackenzie.

(*Communicated by Capt. H. Toynbee.*)

I beg to submit to the consideration of the Royal Astronomical Society the application of the Nicol's prism to sextant observations made at sea, for up to the present moment I am unaware of a polariser having been employed with the sextant. My application of it is as follows. A Nicol's prism is inserted in the inverting telescope on the object-glass side of the diaphragm and close against it, and so placed that when the telescope is screwed home in its collar the polarising plane will be parallel to the plane of the sextant, and consequently perpendicular to the plane of the horizon when making observations. Now at sea observations for time are usually taken when the Sun has an altitude of between 30° and 40° in low latitudes, at which time there is a considerable glare on the horizon, rendering it very indistinct even when the coloured shades are used. In high latitudes, such as that of England, except in midsummer, there is always more or less horizon glare even at the Meridian altitude, so that the advantages of such an instrument would be more striking. The glare of light from the horizon is totally refracted out of the prism, and only the extraordinary ray transmitted to the eye, rendering the horizon comparatively dark and clearly defined, and free from the displacement which coloured shades wanting in parallelism of their faces always give.

I have now employed the instrument at sea during a voyage to the West Indies and South America, and it has fulfilled all I expected of it.

R.M.S. "Moselle," Southampton:
1885, *August* 13.

Ephemeris for Physical Observations of Mars, 1886.

By A. Marth.

Greenwich Noon.	Angle of Position of ♂'s axis.	Areographical Longit. of Centre of Disc.	Areographical Latit. of Centre of Disc.	Diameter.	q	Q	E	Log. Light ratio.
1885.	°	°	°	″	″	°	°	
Dec. 24	20·85	94·49	+23·52	8·30	0·76	292·58	35·32	9·2205
26	21·19	75·65	23·50	8·44	·77	292·53	35·05	·2351
28	21·50	56·83	23·47	8·58	·77	292·47	34·75	·2499
30	21·79	38·05	23·43	8·73	·76	292·40	34·42	·2650
1886.								
Jan. 1	22·07	19·31	+23·39	8·88	0·76	292·33	34·06	9·2804
3	22·33	0·60	23·35	9·04	·76	292·24	33·67	·2960
5	22·57	341·92	23·30	9·20	·75	292·14	33·24	·3118

Greenwich Noon.	Angle of Position of ♂'s axis.	Areographical Longit. of Centre of Disc.	Areographical Latit. of Centre of Disc.	Diameter.	q	Q	E	Log. Light ratio.
1886.	°	°	°	″	″	°	°	
Jan. 7	22·79	323·28	23·25	9·36	·75	292·03	32·78	9·3278
9	22·98	304·69	23·20	9·53	·74	291·92	32·29	·3441
11	23·16	286·14	23·15	9·70	·73	291·79	31·76	·3605
13	23·32	267·63	23·10	9·88	·71	291·64	31·18	·3770
15	23·46	249·17	23·05	10·06	·70	291·48	30·57	·3937
17	23·57	230·75	22·99	10·24	·68	291·31	29·92	·4105
19	23·66	212·37	22·93	10·43	·66	291·13	29·22	·4274
21	23·72	194·05	22·87	10 61	·64	290·92	28·48	·4443
23	23·77	175·77	22·81	10·81	·62	290·69	27·70	·4612
25	23·79	157·55	22·76	11·00	·59	290·44	26·86	·4781
27	23·78	139·38	22·70	11·20	·57	290·17	25·98	·4949
29	23·75	121·27	22·65	11·39	·54	289·87	25·05	·5115
31	23·69	103·21	22·60	11·59	·50	289·53	24·07	·5280
Feb. 2	23·61	85·20	+22·55	11·79	0·47	289·16	23·03	9·5442
4	23·50	67·25	22·50	11·99	·43	288·74	21·95	·5601
6	23·36	49·36	22·46	12·18	·40	288·27	20·81	·5756
8	23·20	31·52	22·41	12·37	·36	287·73	19·62	·5907
10	23·01	13·74	22·37	12·55	·32	287·11	18·38	·6052
12	22·79	356·01	22·33	12·73	·28	286·39	17·09	·6191
14	22·55	338·33	22·29	12·90	·24	285·54	15·76	·6322
16	22·28	320·70	22·25	13·06	·20	284·52	14·39	·6446
18	21·98	303·12	22·21	13·22	·17	283·29	12·97	·6562
20	21·66	285·58	22·17	13·36	·13	281·72	11·52	·6668
22	21·32	268·08	22·14	13·49	·10	279·64	10·03	·6764
24	20 95	250·61	22·10	13·61	·07	277·0	8·54	·6850
26	20·57	233·18	22·07	13·71	·05	273·1	7·03	·6924
28	20·17	215·77	22·04	13·80	·03	268·1	5·54	·6986
Mar. 2	19·75	198·39	+22 00	13·87	0·02	256·9	4·14	9·7036
4	19·33	181·02	21·97	13·92	·01	237·5	2·97	·7073
6	18·89	163·65	21·94	13·95	·01	203·4	2·44	·7096
8	18·45	146·28	21·91	13·96	·01	168·7	2·93	·7106
10	18·01	128·91	21·89	13·95	·02	148·7	4·09	·7103
12	17·57	111·53	21·86	13·93	·03	138·2	5·50	·7087
14	17·13	94·13	21·84	13·89	·05	132·0	7·00	·7058
16	16·71	76·71	21·82	13·83	·08	128·0	8·54	·7016
18	16·29	59·25	21·80	13·75	·11	125·22	10·07	·6963
20	15·89	41·76	21·79	13·66	·14	123·13	11·59	·6948
22	15·51	24·24	21·78	13·56	·18	121·52	13·08	·6823

Greenwich Noon.	Angle of Position of ♂ s axis.	Areographical Longit. of Centre of Disc.	Areographical Latit. of Centre of Disc.	Diameter.	q	Q	E	Log. Light ratio.
1886	°	°	°	″	″	6	°	
Mar. 24	15 15	6·67	21·78	13·44	·22	120·22	14·54	9·6738
26	14·81	349·05	21·78	13·31	·26	119·16	15·97	·6643
28	14·50	331·39	21·79	13·17	·30	118·27	17 36	·6540
30	14·21	313·67	21·81	13·02	·34	117·51	18·71	·6429
Apr. 1	13 95	295·90	+21·83	12·86	0·39	116·85	20·01	9·6311
3	13·71	278·08	21·86	12·69	·43	116·28	21·26	·6187
5	13·51	260·20	21·90	12·52	·48	115·78	22·46	·6058
7	13·34	242·26	21·95	12·35	·52	115·35	23·61	·5924
9	13·20	224·26	22·00	12·17	·56	114·97	24·71	·5786
11	13·09	206·21	22·06	11·99	·60	114·63	25·76	·5645
13	13·01	187·10	22·13	11·81	·63	114·33	26·76	·5501
15	12·96	169·94	22·21	11·62	·67	114·07	27·71	·5356
17	12·95	151·72	22·29	11·44	·70	113·84	28·61	·5209
19	12·96	133·45	22·38	11·26	·73	113·64	29·47	·5061
21	13·00	115·13	22·48	11·08	·76	113·47	30·28	·4913
23	13·07	96·75	22·58	10·91	·78	113·32	31·04	·4764
25	13·17	78·33	22·69	10·73	·80	113·19	31·76	·4616
27	13·29	59·86	22·80	10·56	·82	113·08	32·44	·4469
29	13·44	41·34	22·92	10·39	·84	112·99	33·08	·4322
May 1	13·61	22·78	+23·04	10·22	0·86	112·91	33·69	9·4176
3	13·80	4·18	23·16	10·06	·87	112·85	34·25	·4032
5	14·02	345·53	23·29	9·90	·88	112·80	34·78	·3889
7	14·27	326·84	23·42	9·74	·89	112·77	35·27	·3748
9	14·53	308·11	23·55	9·59	·90	112·75	35·73	·3610
11	14·81	289·34	23·68	9·45	·91	112·74	36·15	·3473
13	15·11	270·54	23·81	9·30	·91	112·73	36·55	·3338
15	15·43	251·70	23·94	9 16	·92	112·74	36·91	·3206
17	15·77	232·82	24·08	9·02	·92	112·75	37·25	·3076
19	16·12	213·91	24·21	8·89	·92	112·77	37·56	·2948
21	16·49	194·98	24·34	8·76	·92	112·79	37·85	·2823
23	16·87	176·01	24·47	8·63	·92	112·81	38·11	·2700
25	17·27	157·01	24·59	8·51	·92	112·84	38·35	·2580
27	17·68	137·98	24·72	8·39	·92	112 88	38·57	·2462
29	18·10	118·93	24·84	8·27	·91	112·91	38·77	·2347
31	18·53	99·85	24·95	8·16	·91	112·95	38·94	·2234
June 2	18·97	80·74	+25·06	8·05	0 90	112·99	39·10	9·2123
4	19·42	61·61	25·17	7·95	·90	113·03	39·24	·2015
6	19·88	42·46	25·27	7·84	·89	113·07	39·36	·1910

Greenwich Noon.	Angle of Position of ♂'s axis.	Areographical Longit. of centre of Disc.	Areographical Latit. of centre of Disc.	Diameter.	q	Q	E	Log. Light ratio.
1886.	°	°	°	″	″	°	°	
June 8	20·35	23·28	25·36	7·74	·88	113·11	39·46	9·1807
10	20·83	4·08	25·45	7·64	·87	113·15	39·55	·1706
12	21·31	344·85	25·53	7·55	·87	113·19	39·62	·1608
14	21·80	325·61	25·60	7·46	·86	113·23	39·67	·1512
16	22·29	306·35	25·67	7·37	·85	113·26	39·71	·1419
18	22·79	287·07	25·73	7·28	·84	113·29	39·74	·1328
20	23·29	267·77	25·78	7·20	·83	113·32	39·76	·1239
22	23·79	248·46	25·82	7·12	·82	113·34	39·77	·1153
24	24·30	229·13	25·85	7·04	·81	113·36	39·76	·1068
26	24·81	209·78	25·87	6·96	·80	113·38	39·74	·0986
28	25·32	190·42	25·88	6·89	·79	113·39	39·71	·0906
30	25·82	171·04	+25·89	6·81	0·78	113·39	39·67	9·0828

Q denotes the position-angle, and q the amount of the greatest defect of illumination; E the areocentric-angle between Earth and Sun. The last column gives the logarithm of the ratio of the apparent brightness of *Mars* to that at mean opposition, computed upon the supposition that the diminution of brightness due to the phase depends simply on the proportion of the unilluminated portion to the whole of the disc. The maximum value of the logarithm of this light-ratio during the last four oppositions has been

1877	Sept. 3	0·3696	1881	Dec. 20	9·8442
1879	Nov. 3	0·1021	1884	Jan. 30	9·7163

while that of the coming opposition is

1886 Mar. 6 9·7106

The data of the ephemeris are to be interpolated directly for the times for which they are required, the equation of light having already been taken into account. The difference of successive values of the longitude of the centre of the disc amounts to one rotation and some 340 degrees, so that, for instance, the difference from December 24 to 26 is 701°·16, which must be borne in mind in interpolating.

As the observations of *Mars* made during the last two oppositions do not seem to have contributed anything further towards a better determination of the position of the planet's equator, I have now made the slight change from the values of the node N and inclination J in reference to the plane of the Earth's equator of 1880·0

$$N = 47°\cdot945 \qquad J = 36°\cdot260,$$

which I had adopted in the ephemeris for 1879 (vide vol. xxxix. p. 473) to those determined by Schiaparelli from his own measurements of 1877 and 1879

$$N = 48^\circ{\cdot}130 \qquad J = 36^\circ{\cdot}382.$$

The Zero-Meridian has also been shifted in order that it may pass, as nearly as Schiaparelli's measurements will permit, through the point of the tongue of the forked bay of Dawes or through Schiaparelli's Fastigium Aryn. The correction applied is $+1^\circ{\cdot}32$ for the beginning of 1880.

I have, further, made the slight change from the daily rate of rotation $350^\circ{\cdot}8922$, which I had used since 1864, to the rate $350^\circ{\cdot}89214$, which I have deduced from what appear to me by far the best old observations available for the purpose—namely, those made by Maraldi in 1704 and the corresponding ones of Schiaparelli made in 1879, as already mentioned in vol. xliii. p. 493. The daily rate $350^\circ{\cdot}89214$ is the tropical one in reference to the equator; the sidereal rate is $0^\circ{\cdot}0000384$ greater, and the corresponding period of the sidereal rotation of *Mars* is $24^h\ 37^m\ 22^s{\cdot}63$, only $0^s{\cdot}01$ greater than Kaiser's value of 1864. In another communication I shall give, for the times assigned to the older sketches, the areographical longitudes and latitudes of the centre of the disc according to the system adopted in the present ephemeris.

It is desirable that the question should be settled how far the variations in the aspect of the dark markings on *Mars* are due to the relative position of the Sun and the Earth, and especially what changes take place in the aspect of a marking, when, in the course of rotation, it reaches or leaves the vicinity of the point where Sun and Earth have the same areocentric zenith distances, but opposite azimuths. Though this point may be found from the data of the ephemeris, as it is in position-angle $Q + 180^\circ$ and at the areocentric angular distance $\frac{1}{2}E$ from the apparent centre of the disc, or geocentrically at the distance $\sin \frac{1}{2}E$ of the semi-diameter, observers may perhaps be more readily induced to watch their opportunities, if they can easily get the areographical longitude ω' and latitude β' of the point. I give, therefore, at intervals of eight days, the difference $\omega' - \omega_\circ$ of the longitude of the point in question from that of the central meridian $\omega_\circ$, and also the latitude β'. In the last column I have added the areocentric longitude of the Sun reckoned in the plane of the orbit from the ascending node of the orbit on the planet's equator, or analogous to the reckoning of the Sun's geocentric longitude in the ecliptic, so that the actual season on *Mars* corresponds to the terrestrial season when the Sun's geocentric longitude is $= \odot'$.

	$\omega'-\omega_\odot$	β'	$\odot'$		$\omega'-\omega_\odot$	β'	$\odot'$
1885.	°	°	°	1886.	°	°	°
Dec. 24	−19·1	+21·8	47·6	Mar. 30	+ 9·9	+23·7	89·7
1886.							
Jan. 1	−18·4	22·2	51·1	April 7	12·6	23·9	93·3
9	−17·5	22·5	54·6	15	14·9	24·2	96·8
17	−16·2	22·7	58·2	23	16·8	24·5	100·4
25	−14·6	22·9	61·7	May 1	18·3	24·7	104·1
Feb. 2	−12·5	23·0	65·1	9	19·5	24·9	107·7
10	− 9·9	23·0	68·6	17	20·5	25·0	111·4
18	− 7·0	23·0	72·1	25	21·1	25·0	115·1
26	− 3·6	23·1	75·6	June 2	21·6	24·9	118·9
Mar. 6	− 0·1	23·2	79·1	10	21·8	24·6	122·7
14	+ 3·5	23·3	82·6	18	21·9	24·3	126·5
22	+ 6·8	+23·4	86·2	26	+21·8	+23·8	130·4